A Level Computer Science

Exam Style Questions

Unit 1.4.2

Data Structures

Hash Tables

Name		Date	

Score	Percentage	Grade
/ 24		

Question 1

A programmer is writing software for a firewall. She is writing code so that it keeps a track of websites that users are permitted to visit. The software stores the websites' addresses along with details about who can view them and when.

The following data is also stored about each website:

- Access level needed (1-4)
- If it is available all the time (true) or just lunch times and out of work hours (false).

So a website which is available to users of access level 2 and above, all the time, would have the details [2, true] stored.

A website accessible to users of access level 3 and above, only outside of work hours, would have the details [3, false] stored.

A flaw with the current hash function is it tends to generate lots of collisions (addresses that compute to the same hash). Below is a diagram of part of the hash table. The address www.rnd.com with details [2, true] is being added to the hash table.

a) Explain how a hash table can be used to handle collisions, referring to the example below.

227	
228	www.ocr.org.uk : [1, true]
229	
230	www.ppf.nz : [2, false]
231	
232	www.ntf.biz : [4, true]
234	
235	

[4]

b) The hash function is changed so there are no longer high numbers of collisions.

During busy periods the firewall is expected to check several addresses a second. It is anticipated that roughly 10 new addresses will be added to a whitelist (list of acceptable addresses) each day.

There is a debate as to whether a hash table (with the new hash function) is the best approach, or if the whitelist would be better stored in a linked list.

Discuss whether a hash table or linked list is better to store acceptable websites. You should compare how each structure can be searched and has data added and come to a recommendation as to which is better for the whitelist.

[12]

Question 2

A bus runs between two cities. There are a number of stops on the bus route labelled StopA, StopB and so on. The timetable for the route is represented as a hash table. For each entry in the hash table the key is the bus stop code and the data attached to it is a (zero indexed) array of the times a bus arrives at the stop. The times are stored as strings.

An extract of the hash table is shown below:

```
times=
{
"StopA":["06:55","07:25","07:55","08:55","09:55","11:55","14:00",
"15:00", "15:30","16:00"]
"StopB":["06:40","07:40","08:40","09:20","09:40","14:00","15:00",
"16:00","16:30"]
…
…
}

print(times["StopA"][1])        displays: 07:25
```

a) State what the code print (times["StopB"] [4]) displays.

[1]

b) Write a function called timeValue that given a time stored in a string, returns the equivalent integer (using thousands and hundreds for the hours and tens and units for the minutes). The given string should be assumed to represent the time in the 24-hour clock in the format HH:MM

timeValue ("07:55") should return 755
timeValue ("15:30") should return 1530

[3]

4

Question 3

A coach company offers tours of the UK. The program stores records about its customers.

Often an individual customer's record needs to be accessed. This is done by searching using the Customer ID. Explain why a hash table is better suited than a linked list to store the customer records, particularly as the company acquires more customers.

[4]